Mike Parnell, President, Wire Rope & Rigging Consultants

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To: Jeff Asperger, Attorney, Asperger Associates

From: Mike Parnell, WRRC **Date: October 26, 2005**

Subject: Tate & Lyle v. M/V Leon I, et al.

Dear Mr. Asperger,

The following is in answer to inquiries between you and Attorney Robert Clyne, about the accumulated pitting, corrosion and abraded surfaces noted on the wires in the luffing wire (boom hoist rope) on Crane 4 aboard the M/V Leon I, involved in the accident of July 29, 2000.

Based on the visual examination of the boom hoist rope, the photos provided throughout this case, and with the consultation of Mr. Don Pellow, P.E. a noted wire rope expert who has testified in court concerning wire rope related corrosion and pitting;

1) I am of the opinion that the condition of the abraded (scrubbed and chaffed) wires in the immediate area of the failure was in existence at least two years before July 29, 2000. There is pitting corrosion imbedded in the flat scraped portions of the wires, alongside the general pitting corrosion visible within 1"-6" of the scrapped areas. Note photos EC00: 2667, 2668, 2669, 2740.

2) I am of the opinion that the pitting corrosion noted on outer and inner strand wires was in existence at least two years before July 29, 2000. Note photos EC00: 2670, 2671, 2675.

Please see Mr. Pellow's attached report (C350675.pdf) which helped me to form a more definitive opinion about the length of time the pitting corrosion and metal loss existed before the accident.

Respectfully submitted,

Mike Parnell
President
Wire Rope & Rigging Consultants

PELLOW ENGINEERING SERVICES
DONALD L. PELLOW, P.E.

October 25, 2005

Mr. Mike Parnell
Wire Rope & Rigging Consultants
9428 Old Pacific Highway
Woodland, WA 98674

Ref.: Wire Rope Evaluation
Tate & Lyle v. M/V Leon I
DOA July 29, 2000

Dear Mike:

In response to your request of reviewing the photographs of the wire rope involved in litigation and in evaluating the corrosion of the wire rope from these, all photographs were examined carefully and with the aid of a magnifying glass. Following are my opinions which are based upon my 39 years of experience in the wire rope industry; my involvement in analyzing hundreds of corroded wire ropes; my engineering education and background in wire rope engineering and failure analysis; and technical industry references, such as the ASM Handbook, Volume 11, entitled "Failure Analysis and Prevention".

Much of the wire rope is heavily coated with a grease or lubricant (Photograph #2) and appears to have been re-lubricated in the field. However, there are many areas in the wire rope that have lost this grease/lubricant, possibly from field service, post-accident inspection or other handling events (Photographs #23 & #24).

At the failure end, the wires in one strand reveal outer abrasion on the ends of the wire breaks, and a close-up of the strand surface at the break shows advanced pitting of the wire surfaces (Photograph EC002667). Other areas of the wire rope have broken wires which have broken during service and then been allowed to subsequently operate over sheaves and/or drums (Photograph EC 002668 & 002669). This is evident from the broken wires being bent back on themselves and forced against the wire rope surface. These same photographs reveal abraded areas on the wire rope surface and outer wires with deep pitting corrosion. This corrosion is revealed after the outer coating of grease/lubricant has been partially removed.

Photograph EC 002670 & 002671 exhibit outer and inner strand wires with highly advanced pitting corrosion and loss of significant cross-sectional steel area. These photographs also reveal that several wires have been heavily gouged and abraded at locations along the wire rope.

At least some of the wire rope was in a highly corroded condition prior to it being re-lubricated in the field (Photograph EC 002675). This becomes evident after the outer wires were removed, thus revealing heavy corrosion on the inner strand wires.

Cutting and gouging of outer strand wires is evident in Photographs EC 002736 & 002739. Photograph EC 002740 shows this same condition plus the fact that the heavily corroded and pitted wires have lost a considerable amount of cross-sectional steel area.

It is obvious that the thick, grease/lubricant applied in the field only covered the outer surfaces and did not penetrate to the inner portions of the wire rope (Photograph EC 2728). This photograph, along with EC 002697, also confirms that the grease/lubricant was applied over a severely corroded wire rope in at least some areas. That is, in areas where the grease/lubricant is removed from the wire rope surface, highly corroded wires are exposed.

Several conclusions can be made from this evaluation:

1. The grease/lubricant applied in the field has been placed over at least some areas of severe, pitting corrosion of wires. In many instances, even the inner strand wires are severely pitted from corrosion.
2. The severe nature of much of the pitting corrosion on the wires has resulted in appreciable loss of cross-sectional steel area, which leads directly into loss of overall wire rope strength. The strength of the wire rope is further reduced by the absence of lubrication, which is necessary to achieve full strength. That is, without lubrication, the wires are unable to properly adjust and equally distribute loading during operation and movement of the wire rope over sheaves or around drums.
3. Various sections of the wire rope have been subjected to heavy gouging, cutting and abrasion. This has resulted in wires being cut almost in two and being abraded through much of the cross-section.
4. From the appearance of the pitting corrosion of the wires (i.e., the depth of the pitting, the loss of cross-sectional steel area and the dark, red color of the corrosion), the severe nature of the rusting and corrosion of the wire rope would have been obvious at least two years or greater.

Corrosion of a wire rope evolves through several stages as it progresses to the conditions as seen in these photographs. The first stage initiates after all corrosion protection from the lubrication is lost. This is a light covering of surface rust that is light red in color, and can be easily wiped from the surface. At this time, the wire rope can be wiped and re-lubricated with a penetrating lubricant. If this is not performed, the next stage of corrosion is a thicker, darker red color of rust. This type of corrosion can often result in steel flaking from the wires as the wire rope operates over sheaves or around drums. This action results in a slight loss of steel area, and once again exposes bright steel under the corrosion to the environment. If this stage two corrosion remains on the wire surfaces, the corrosion will continue to develop under the same environmental conditions of moisture and salt air environment; however, the rate of corrosion will decrease. The reason for this

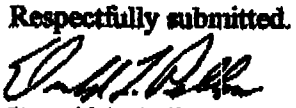
decreased rate is that the corrosion or rust cover acts as a coating over the bright steel surface, thus inhibiting the rate of oxidation.

If this second stage of corrosion remains intact, the oxidation continues under the outer rust cover and further attacks the steel surface, but in small pin head areas. This results in the initiation of pitting corrosion. If this corrosion were to be scraped from the wire surfaces, small dimples or impressions would be evident in the surfaces of the wires. As the corrosion process continues, the pitting of the wire surfaces continues to worsen with wider and deeper penetration into the wire surface. The color of the corrosion will darken as it progresses.

Finally, the pitting of the wires begins to spread and penetrate deeper into the wires resulting in the loss of significant cross-sectional steel area. This is the condition of many of the wires as observed in the photographs evaluated. It is at this stage that the wires lose considerable strength, and the wire rope in turn loses strength from this loss of steel area plus the inability to equally distribute the loading among all the wires.

It should be mentioned that if the wire rope is removed from the corrosive environment and stored away inside a building or container, the corrosion process is almost completely halted. This has been proven over the years when evidence (wire rope in this situation) is taken from a field site and stored for future investigation.

Respectfully submitted.



Donald L. Pellow – P.E.
Engineering Consultant

CURRICULUM VITAE

Donald L. Pellow - P.E.
Engineering Consultant
Wire Rope, Slings & Rigging

PELLOW ENGINEERING SERVICES, INC.
406 West 50 th Street
Kansas City, MO 64112
Tel / FAX 816-931-4113 E-Mail: DPellow@AOL.com
Website: www.pellow.4t.com

PERSONAL STATEMENT

Registered Professional Engineer providing field investigation, failure analysis, laboratory testing and expert testimony in Product Litigation; in-depth classroom and field training on rigging and wire rope products; and field evaluation and problem solving of products used on construction, industrial, petroleum and mining equipment. Products include wire rope; wire rope, synthetic & chain slings; wire rope fittings; galvanized & structural strand; and prestressed concrete strand. Over 38 years in the wire rope industry with expertise in design, engineering, production, testing and field usage of these products. More than 30 years in engineering assistance and as an expert witness in product litigation for Armco-Union Wire Rope, Wire Rope Corporation of America and other manufacturers and users of wire rope, strand and rigging products. More than 30 years as a speaker at industry seminars and national symposiums. Accomplished trainer of engineers, riggers and sales personnel.

Education

Degrees:

- Bachelor of Science - Engineering Physics
  University of Kansas; Lawrence, Kansas
- Business Certificate
  Alexander Hamilton Institute; New York, New York

Management / Technical Training

- Metallurgical Training Program
  Armco Steel Corp.; Kansas City, Missouri
- Models for Management
  Armco Steel Corp.; Middletown, Ohio
- Commercial and Technical Sales Training
  Armco Steel Corp.; Middletown, Ohio

Quality Management Training

- Philip Crosby College
  Winter Park, Florida
- ISO 9000 & Total Quality Management Technical Development
  National Society of Professional Engineers; San Francisco, California
- Design of Experiments
  Taguchi Method

EXPERT WITNESS EXPERIENCE

- 30 + years as an expert witness and engineering consultant for Armco-Union Wire Rope, Wire Rope Corporation of America, and other wire rope manufacturers and users of wire rope, strand, slings and rigging products. Involves field analysis of failures; metallurgical and physical testing; micro and macro photographic work; technical report writing; and testimony in depositions and court trials.
- Expert witness and engineering consultant for Pellow Engineering Services, Inc. since March, 1994

PROFESSIONAL ORGANIZATIONS

- Registered Engineer in the states of Missouri and Kansas
- National Society of Professional Engineers
- Missouri Society of Professional Engineers
- Past Chairman of the Wire Rope Technical Board
- Past Chairman - Prestressing Steel Committee of Prestessed Conc. Institute
- Past member of American Society of Quality
- University of Kansas - Structural Engineering Conference Advisory Council
- University of Wisconsin - Annual speaker at Crane Safety Seminar
- Member of the Associated Wire Rope Fabricators (AWRF)
- Chairman of the Technical Committee of AWRF
- Chairman of the American Society of Senior Wire Rope Engineers
- Greater Kansas City Chamber of Commerce
- Member of the Plaza Rotary Club of Kansas City

PERSONAL AWARDS AND ACCOMPLISHMENTS

Outstanding Speaker Awards at seminars sponsored by:

- Peabody International
- Corps of Engineers
- Associated Wire Rope Fabricators
- Society of Automotive Engineers
- University of Wisconsin

- Patent on 10 x 19 Rotation - Resistant Wire Rope
- Past Chairman of Industry Task Force on Rotational Properties of Wire Rope
- Developed Wire Rope Specifications for the Towing Cables on the Panama Canal
- Consulted in the Development of Wire Rope Specifications for the San Francisco Cable Cars
- Wrote and Published Technical Bulletins on Wire Rope for Union Wire Rope
- Past instructor for Level III Rigging Gear Inspection - WRRC

PUBLISHED ARTICLES

- "Wire Rope Design Factors"; Engineering and Mining Journal and Transportation Engineer
- "Mining Wire Rope"; Coal Age
- "Get Better Service from Wire Rope Slings"; Drilling
- "Wire Rope Slings"; Plant Engineering
- "Low-Relaxation Strand"; Prestressed Concrete Institute Journal
- "Changing Times in Wire & Prestressing Strand"; Wire Journal International
- "Block-Spinning on Cranes Using Multiple-Part Reeving"; Society of Automotive Engineers
- "Block-Spinning Burdens"; Crane Works
- "Anatomy of an Accident" (crane failure); Crane Works
- "Wire Rope Selections"; Crane Works
- "Anatomy of an Accident" (boom hoist failure); Crane Works
- "Slingmax Gator-Max & Gator-Laid Slings"; Wire Rope News & Sling Technology
- "New Composite Yarn Developed for Slingmax-TPXC Twin-Path Extra Slings"; Wire Rope News & Sling Technology

EMPLOYMENT HISTORY

- 1994 - Present

  President of Pellow Engineering Services, Inc. a Professional Engineering Consulting Firm providing the following services:

  - Field Investigation, Product Usage Training, Rigging Training, and Expert Testimony in Product Litigation
  - Engineering and Technical Training on Wire Rope, Strand, Rigging, Sling Products, OSHA Regulations ,Industry Specifications and Inspection Criteria
  - Development of Quality Standards and Manuals for Total Quality Management Programs and ISO Certification
  - Classroom and Practical Hands-On Rigging Training
  - Rigging & Crane Publications (Bob's Rigging & Crane Handbooks & Crane Reference Cards) for industry training and field applications

1992-1994
Director of Quality Processes
Wire Rope Corporation of America
- Initiate TQM and ISO Direction for the company

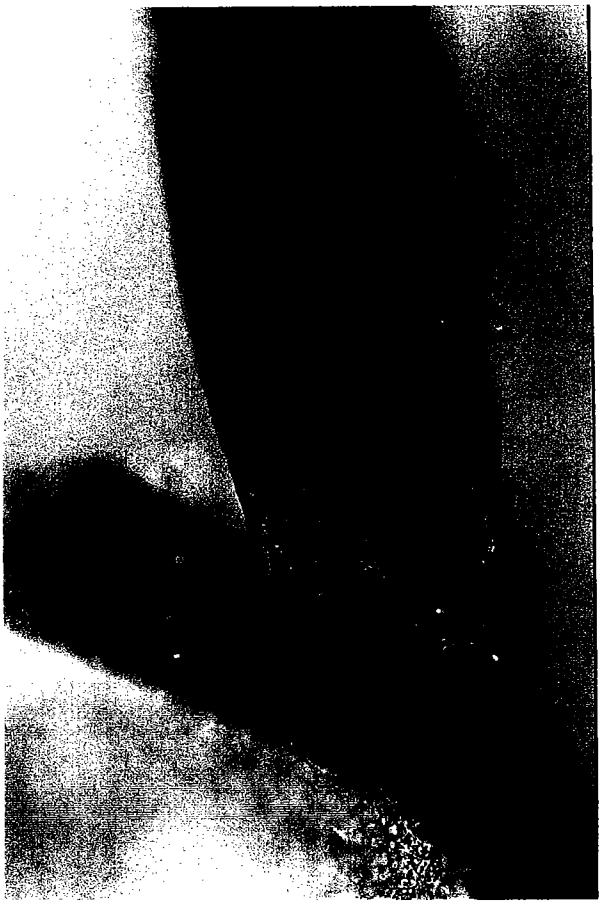
1988-1992
Manager of Product Engineering
Wire Rope Corporation of America
- Integrated Engineering Design, Education, Product Performance Analysis, Quality Standards and Product Development of Union Wire Rope into Wire Rope Corporation of America
- Corporate Representative to the Prestressed Concrete Institute
- Assumed Leadership Roles as Chairman of Industry Trade Associations

1985-1988
Manager of Technical Services
Armco-Union Wire Rope
- Managed the Engineering Department with responsibilities of Design, Research & Development, Field Applications, and Complaint Analysis of all Wire Rope Products
- Developed and Initiated Training for Engineers and Sales Personnel
- Managed the Development of Low-Relaxation Prestressing Strand
- Wrote & Published Technical Articles for Industry Magazines and Product Data Bulletins
- Accomplished Speaker at National Symposiums and Training Seminars
- Represented Armco-Union Wire Rope as the Expert Witness in Product Litigation
- Participated in Trade and Engineering Associations

Up through 1985
Worked through the positions of Engineer, Senior Engineer and Supervisor of Technical Services at Armco-Union Wire Rope.

PROFESSIONAL & PERSONAL REFERENCES AVAILABLE UPON REQUEST

EC002736



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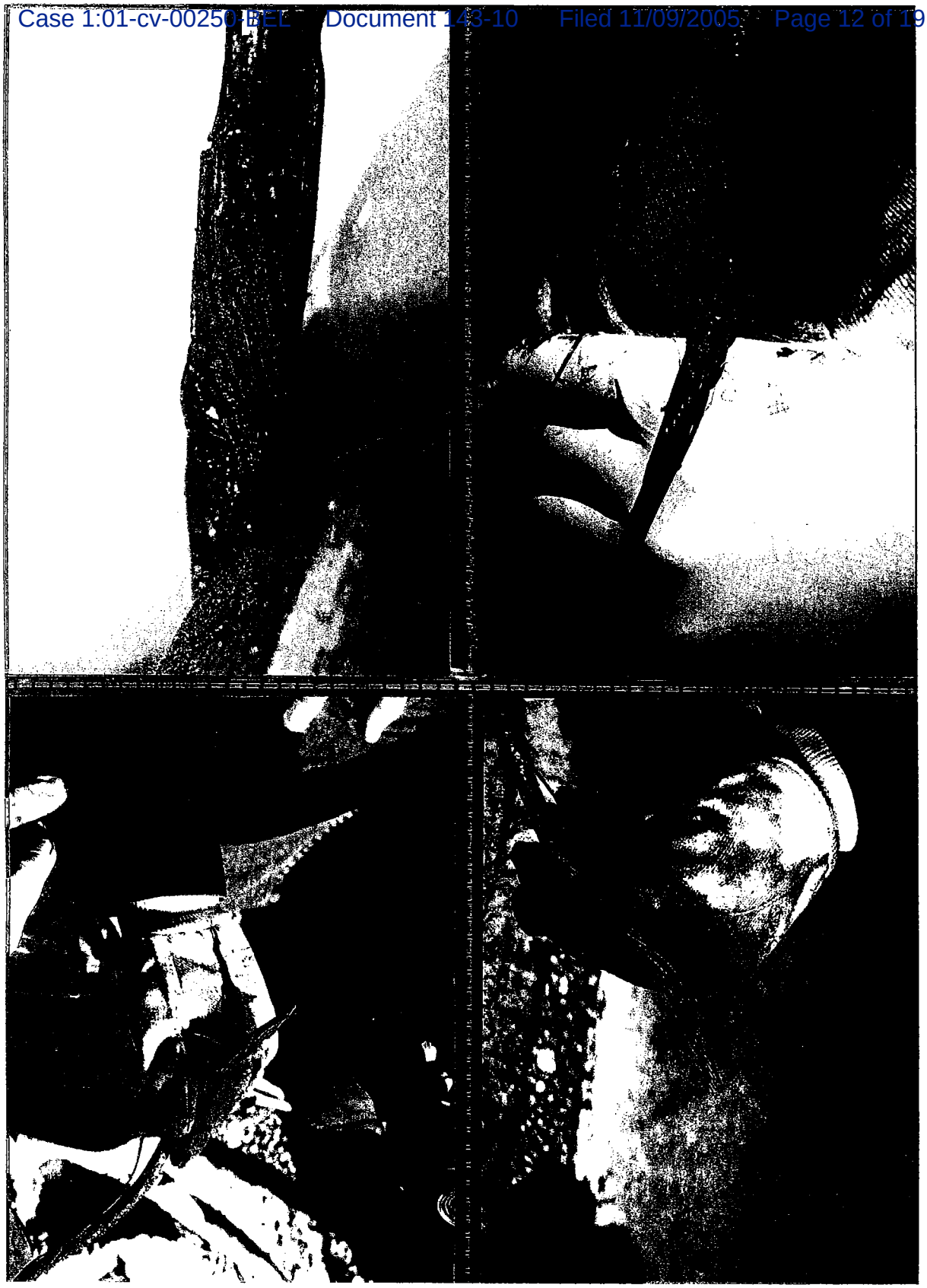

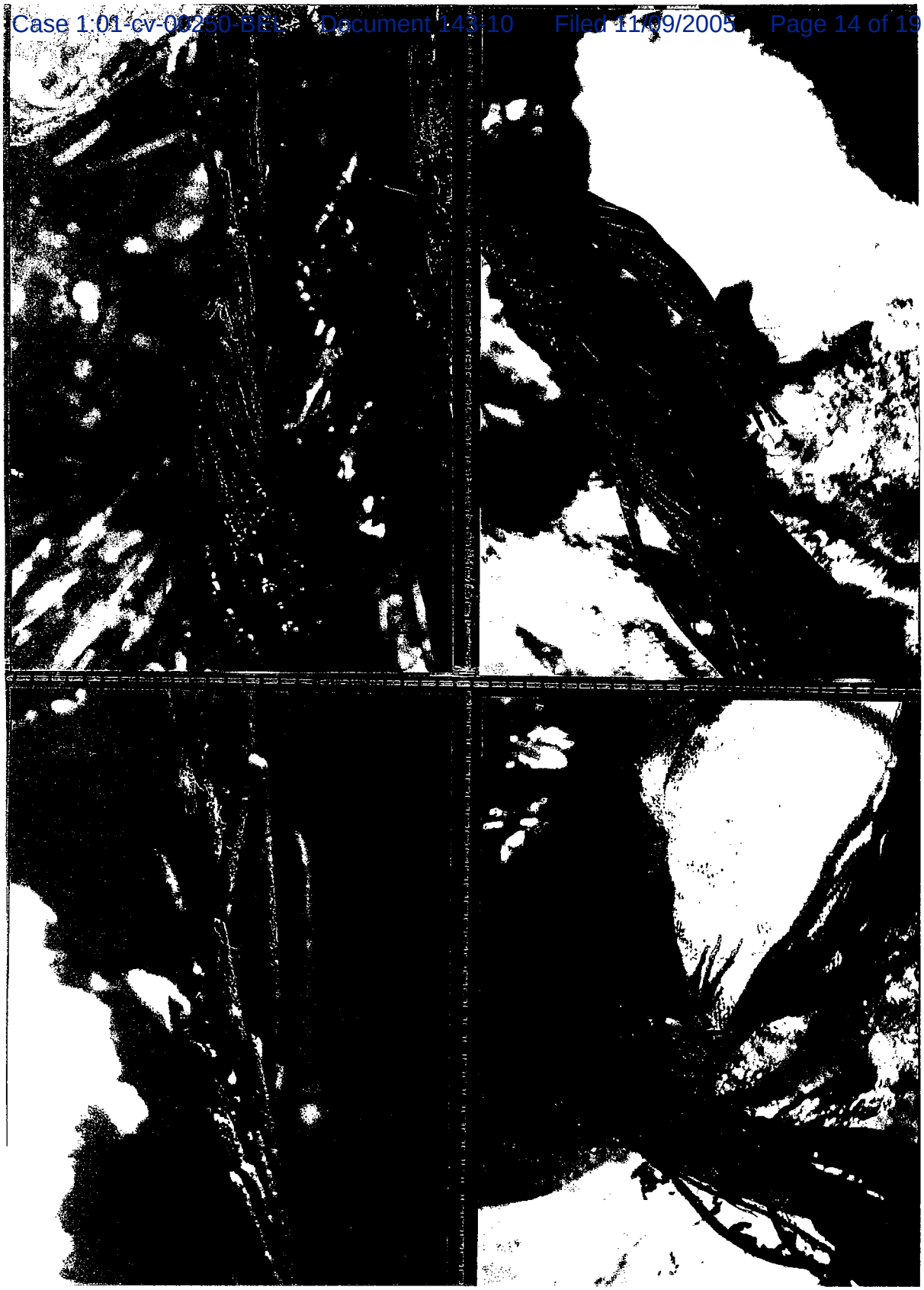

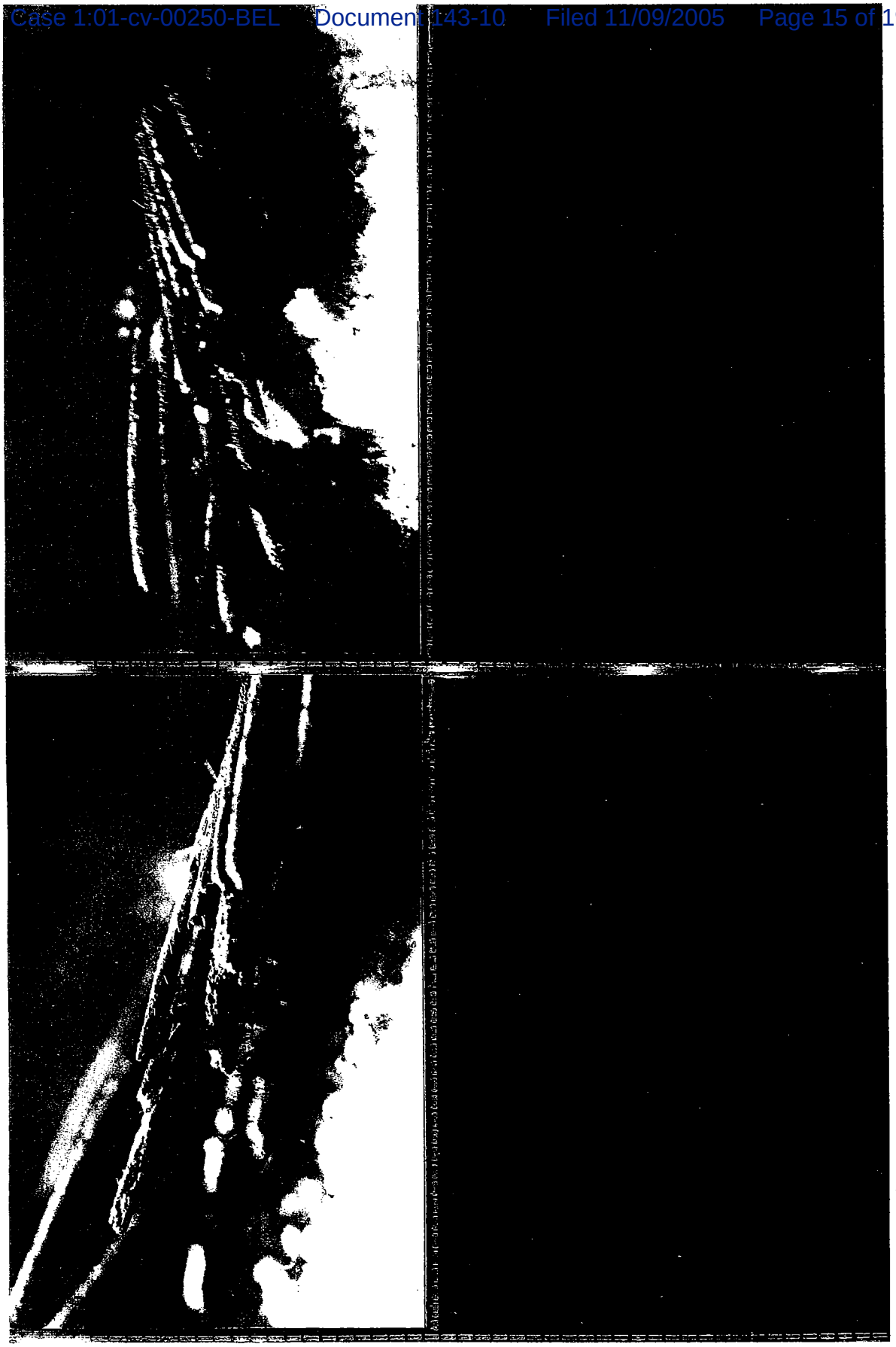

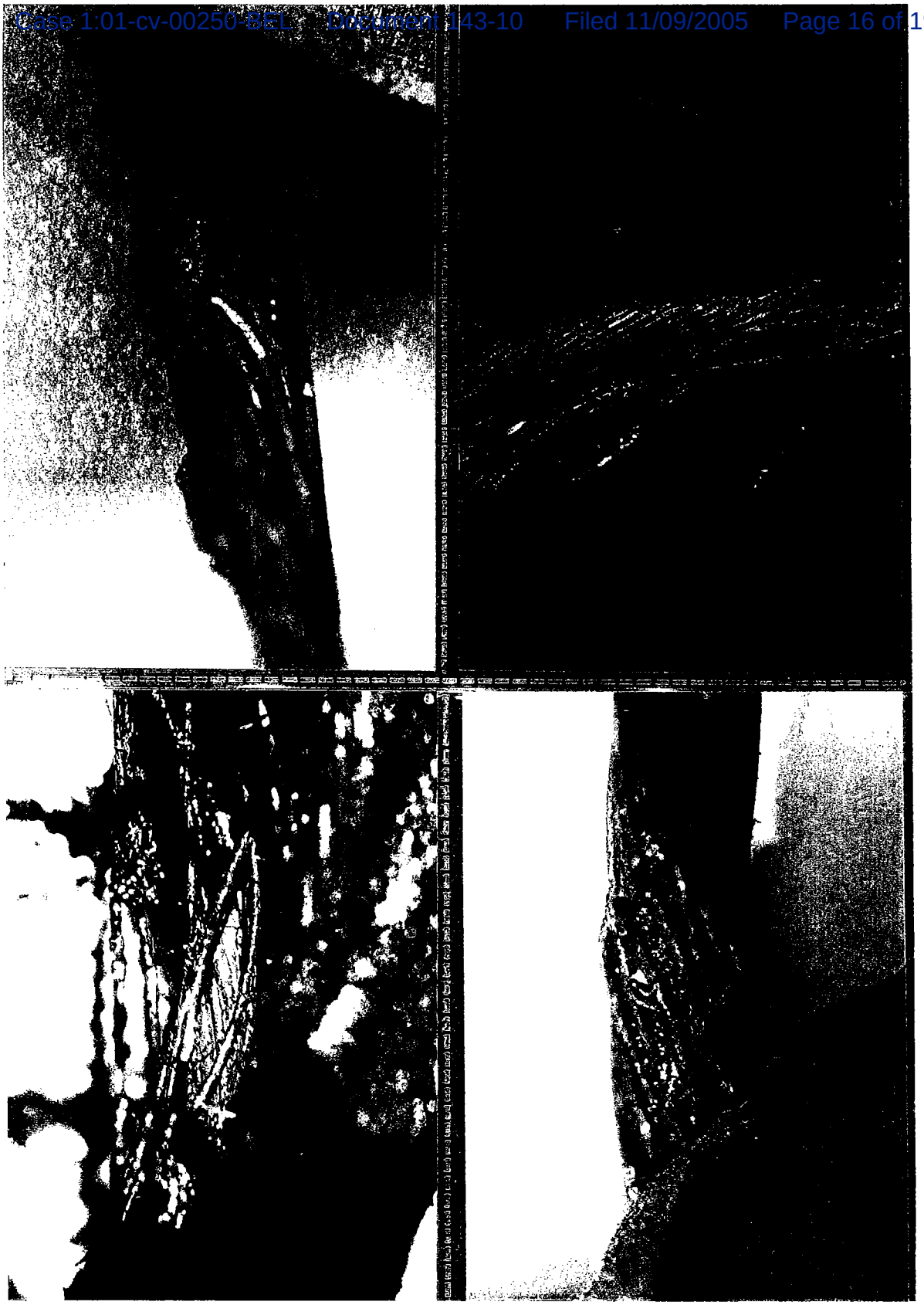

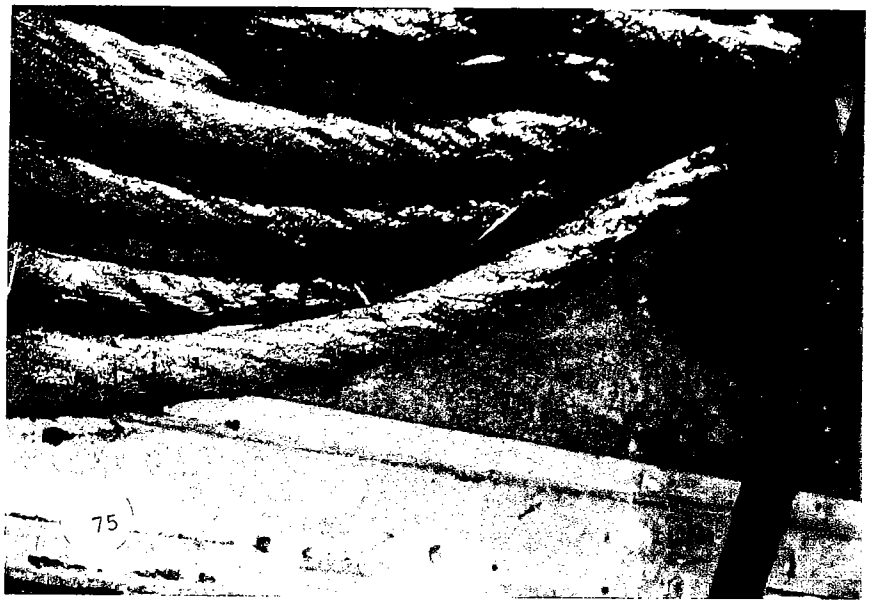

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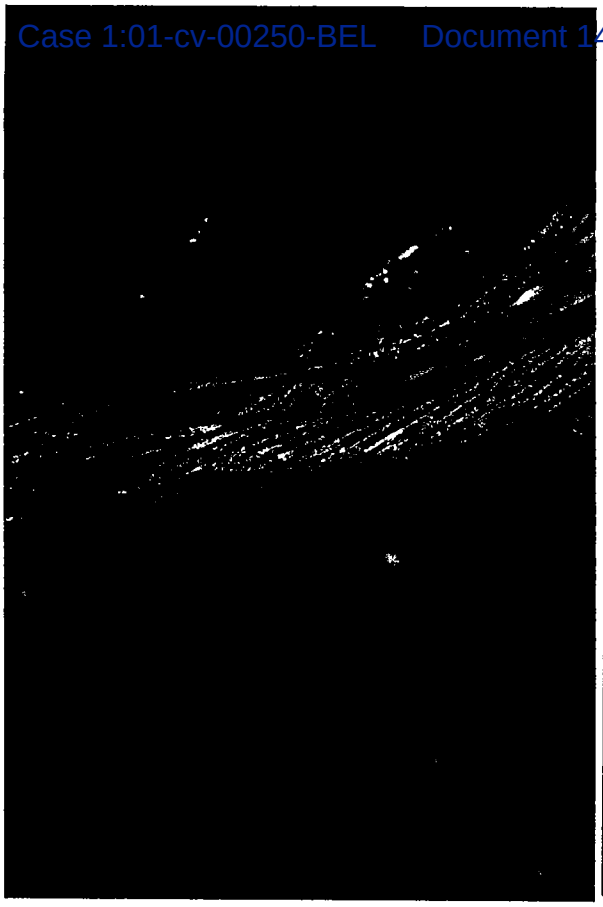

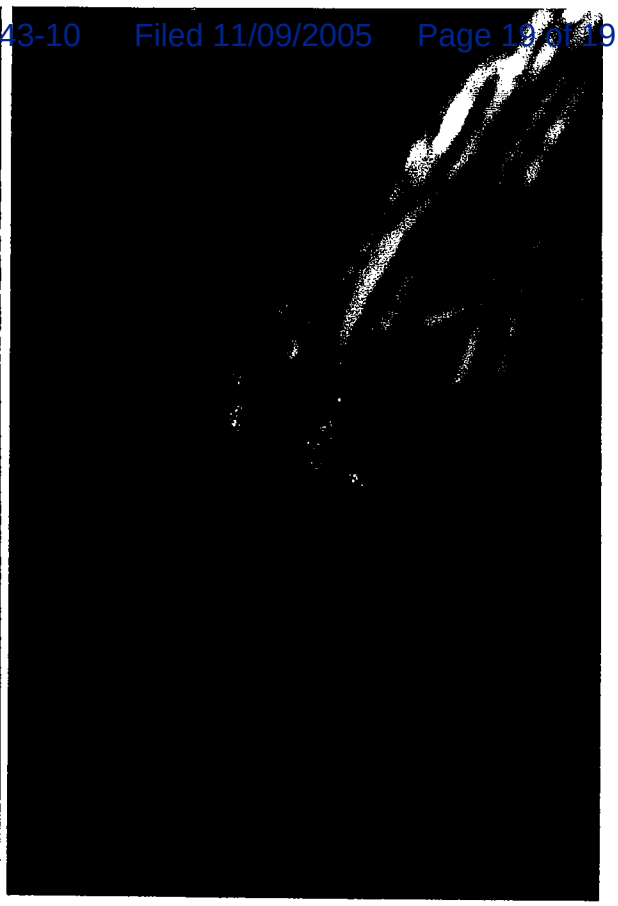

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